

REMARKS

1. In response to the Office Action mailed February 17, 2009, Applicants respectfully request reconsideration. Claims 1-7, 9-11 and 13-21 were last presented for examination. In the outstanding Office Action, all claims are rejected. By the foregoing amendments, no claims have been amended, cancelled or added. Thus, upon entry of this paper, claims 1-7, 9-11 and 13-21 will be pending in this application. Of these nineteen (19) claims, three (3) claims (claims 1, 9 and 16) are independent.

2. Based upon the above Amendments and following Remarks, Applicants respectfully request that all outstanding objections and rejections be reconsidered, and that they be withdrawn.

Claim Rejections under 35 U.S.C. §103 in view of Yang and Hui

3. The Examiner has rejected claims 1-2, 5-7, 9, 14-16 and 19-21 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 7,206,418 to Yang et al., (hereinafter, “Yang”) in view of U.S. Patent No. 6,999,541 to Hui, (hereinafter, “Hui”). Applicants respectfully request that the Examiner reconsider and withdraw these rejections for at least the following reasons. First, the Examiner has failed to provide an appropriate basis to support the proposed combination of Yang and Hui. Second, even if the references were combined as suggested by the Examiner, the proposed combination would still not contain all elements of Applicants’ claims.

The Combination of Yang and Hui is Prima Facie Improper

4. The proposed combination of Yang and Hui is *prima facie* improper because the Examiner has failed to provide an appropriate basis for making the proposed combination. As stated by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, “a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently known in the prior art.” (127 S.Ct. 1727, 1741 (2007).) The Supreme Court recognized that “rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some ***articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.***” (See *KSR*, 127 S.Ct. at 1741 (citing *In re Kahn*, 441 F.3d 977, 988 (C.A.Fed. 2006); emphasis added.) Applicants submit that the Examiner has completely failed to satisfy these legal obligations. The Examiner has done what has been viewed as circumspect

by the Supreme Court and has only provided a conclusory and unsupported statement to justify the proposed combination of Yang and Hui. Prior to addressing the Examiners conclusory statement, each of the cited references are briefly described below.

5. Yang is generally directed to a device which receives and converts two sound signals into a single substantially noise free output. (*See*, Yang, col. 2, lns. 13-53.) The two detected signals, each comprising a speech component and a noise component, are each provided to first and second beam forming units. (*See*, Yang, col. 5, lns. 1-7.) The first beam forming unit converts the two microphone signals into a first signal $s(t)$ comprising a speech component and a noise component. (*See*, Yang, col. 5, lns. 8-21.) The second beam forming unit converts the two microphone signals into a second mostly noise signal $x(t)$. (*See*, Yang, col. 5, lns. 22-29.) Signals $s(t)$ and $x(t)$ are ultimately provided to a noise suppression unit for further processing. (*See*, Yang, col. 2, lns. 30-53.)

6. Various embodiments of a noise suppression circuit are disclosed in Yang. (*See*, Yang, FIGS. 2, 4-6; col. 9, ln. 35- col. 12, ln 52.) In the outstanding Office Action, the Examiner relies upon the specific embodiment described with reference to FIG. 4 to reject Applicants' claims under §103. (*See*, Office Action, pg. 2.) In order to properly respond to the Examiner's rejections, Applicants provide below a summary of the noise suppression circuit described with reference to FIG. 4 of Yang. Although not discussed further herein, it should also be appreciated that Applicants' claimed invention is equally patentable over all other embodiments of Yang, taken alone, or in combination with Hui.

7. In the embodiment of FIG. 4, Yang's noise suppression unit comprises a pre-filter 432, voice activity detector 440, filter 450, summer 434 and spectrum subtraction unit 460. (*See*, Yang, col. 9, lns. 40-49; Figure 4.) The speech plus noise signal $s(t)$ is provided to the pre-filter 432 to remove high frequency components, and this filtered version of $s(t)$ is provided to the summer 434. (*See*, Yang, col. 9, lns. 40-49.) The mostly noise signal $x(t)$ is provided to the filter 450. The filter 450 "filters the noise with a particular transfer function $h(t)$ " which "describes the correlation between the noise components received on $s(t)$ and $x(t)$." (*See*, Yang, col. 9, lns. 40-49; col. 10, lns. 3-18.) When the signal $x(t)$ is provided to the filter 450, the filter "filters the mostly noise signal $x(t)$ with the transfer function $h(t)$ to provide the filtered noise

$p(t)$, which is an estimate of the noise in the signal $s(t)$.” (See, Yang, col. 10, lns. 3-18.) Using summer 434, the estimated noise $p(t)$ is then subtracted from the filtered version of $s(t)$ “to generate the intermediate signal $d(t)$.” (See, Yang, col. 10, lns. 3-18.) The intermediate signal $d(t)$ “represents the error between the between the noise received on the signal $s(t)$ and the estimated noise $p(t)$.” (See, Yang, col. 10, lns. 3-18.) Intermediate signal $d(t)$ is then provided to a spectrum subtraction unit (460). (See, Yang, col. 10, lns. 3-18.)

8. Yang’s spectrum subtraction circuit 460 is designed to use intermediate signal $d(t)$ to provide an output signal $y(t)$ that is predominately speech, and which has a large amount of the noise removed there from. (See, Yang, col. 10, lns. 19-24.) Spectrum subtraction circuit 460 is essentially an additional noise suppression unit that is implemented as described with reference to FIG. 2 of Yang. (See, Yang, col. 10, lns. 19-24.) The details of spectrum subtraction circuit 460 are not relevant to the following discussion and, as such, are not described further herein.

9. Hui is generally directed to a signal processor configured to reduce noise within a received signal. (See, Hui, col. 4, lns. 22-51.) The processor of Hui comprises four main blocks, namely (1) a Preliminary Signal Parameters Estimator and Decision Processor 42, (hereinafter, “PSPE 42”), (2) an Adaptive Spatial Filter 44, (hereinafter, “ASF 44”), (3) an Adaptive Linear Interference and Noise Estimator 46, (hereinafter, “ALE 46”), and (4) an Adaptive Linear Interference and Noise Cancellation and Suppression Processor 48, (hereinafter, “ASP 48”). (See, Hui, col. 4, lns. 52-67.) PSPE 42 essentially functions to determine if a target signal has been received by an array of microphones connected to the signal processor. (See, Hui, col. 5, ln. 15- col. 6, ln. 50.) If PSPE 42 determines that a target signal has been received, the target signal is forwarded to ASF 44. (See, Hui, col. 6, ln. 50-62.) Although PSPE 42 performs other functions, those functions are not relevant to the following discussion and are not discussed further herein.

10. ASF 44 of Hui is configured to convert the target signal into several outputs. (See, Hui, col. 6, lns. 51-62.) A first output, referred to as the sum channel signal (S_c), comprises the ‘target signal plus noise,’ while the remaining outputs, referred to as difference channel signals, comprise ‘noise only.’ (See, Hui, col. 6, lns. 51-62.) The sum channel signal and difference channel signals are provided to ALE 46. (See, Hui, col. 7, lns. 15-21.) The purpose of ALE 46

is to utilize the difference channel signals to reduce the noise within the sum channel to a small error signal (e_c). (See, Hui, col. 7, lns. 15-21.) More specifically, ALE 46 filters each of the difference channel signals, and the filter signals are subtracted from the sum channel signal to form e_c . (See, Hui, col. 13, lns. 7-18.) The outputs of ALE 46 are the sum channel signal, e_c , and the filtered difference channel signals. (See, Hui, col. 7, lns. 33-48.) These signals are then provided to ASP 48. (See, Hui, col. 7, lns. 33-48.)

11. At ASP 48, the weighted average $S(t)$ of the sum channel and error signal e_c is calculated. (See, Hui, col. 7, lns. 33-48.) Furthermore, the filtered difference channel signals are summed to form a single signal $I(t)$. (See, Hui, col. 7, lns. 33-48.) Over a period time, N samples of $S(t)$ and $I(t)$ are formed into vectors and converted into the frequency domain where additional processing is performed to further suppress the unwanted signal (noise). (See, Hui, col. 7, col. 7, ln. 33- col. 8, ln. 9; col. 14, ln. 7- col. 18, ln. 45; claim 1.)

12. In the Office Action, the Examiner relies upon Yang to teach substantially all elements of Applicants' claims." (See, Office Action, pg. 2.) However, the Examiner recognizes that Yang fails to disclose Applicants' claimed "filtering operation." (See, Office Action, pgs. 2-3.) The Examiner relies upon Hui to allegedly disclose that which is missing from Yang. (See, Office Action, pg. 3.) The Examiner then concludes that "[t]hus, taking the combined teaching of Yang et al. and Hui as a whole, it would have been obvious for one of ordinary skill in the art to have modified Yang et al. with the filtering operation... for improving the noise cancellation in the presence of leakage of wanted signals in the channels." (See, Office Action, pg. 3.) Applicants assert that this conclusory statement provided by the Examiner clearly does not provide a rational underpinning to explain the proposed combination of Yang and Hui.

13. As noted above, signals $s(t)$ and $x(t)$ of Yang are provided to a noise suppression unit where a filter 450 "filters the mostly noise signal $x(t)$ with the transfer function $h(t)$ to provide the filtered noise $p(t)$, which is an estimate of the noise in the signal $s(t)$." (See, Yang, col. 10, lns. 3-18.) The estimated noise $p(t)$ is subtracted from a filtered version of $s(t)$ "to generate the intermediate signal $d(t)$." (See, Yang, col. 10, lns. 3-18.) Hui discloses a very similar system in which difference channel signals (mostly noise signals) are filtered and subtracted from a sum channel signal (mostly target signal) to generate an error signal e_c . (See, Hui, col. 7, col. 7, lns.

15-21.) Yang and Hui then use the generated error signals to perform additional operations that eliminate noise from a target signal. As such, the operations of Yang and Hui are similar, and Yang improve noise cancellation in the presence of wanted signals (speech signals) in the channels (mostly noise signals). Because Yang provides the benefits of Hui in a very similar manner as that of Hui, Applicants assert that one of ordinary skill in the art would not be motivated to modify Yang to include the teachings of Hui.

14. The above cited case law makes it evident that without a clear, articulated reason having some rational underpinning to explain the proposed combination, an obviousness rejection under 35 U.S.C. §103 cannot be maintained. (*See KSR.*, 127 S.Ct. at 1741.) Because, as explained above, the Examiner has completely failed to provide any rational underpinning to justify the proposed combination, Applicants assert that the proposed combination of Yang and Hui is *prima facie* improper and that the rejections under 35 U.S.C. §103 should be reconsidered and withdrawn.

***The Proposed Combination Still Does not Contain
All Elements of Applicants' Claims***

15. As set forth in §2142 of the M.P.E.P., “to establish a *prima facie* case of obviousness... the prior art reference (or references when combined) must teach or suggest all of the claim limitations.” Applicants respectfully assert that even if the references were combined as proposed by the Examiner, the resulting combination would still fail to teach all elements of Applicants’ claimed invention.

Claim 1

16. Applicants’ claim 1 is directed to a “method of reducing noise in a speech signal.” (*See*, Applicants’ claim 1, above.) The method comprises: outputting “a speech reference signal comprising a desired signal and a noise contribution, and at least one noise reference signal comprising a speech leakage contribution and a noise contribution; applying a filtering operation to said at least one noise reference signal; and subtracting from said speech reference signal said filtered at least one noise reference signal to provide an output version of said speech signal having reduced noise therein.” (*See*, Applicants’ claim 1, above.) The “filtering operation of said at least one noise reference signal is performed with one or more filters having filter

coefficients configured to minimize the weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal.” (*See*, Applicants’ claim 1, above.) The “speech distortion energy” is the “energy of said speech leakage contributions” and the “residual noise energy” is the “energy of said noise contributions in said speech reference signal and in said at least one noise reference signal.” (*See*, Applicants’ claim 1, above.)

17. As recognized by the Examiner, Yang fails to disclose a filter “having filter coefficients configured to minimize the weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. (*See*, Office Action, pgs. 2-3.) However, in the outstanding Office Action, the Examiner asserts that Hui discloses the “filtering operation” recited in Applicants’ claim 1. (*See*, Office Action, pg. 3.) As support for this assertion, the Examiner directs Applicants to several different sections of Hui that describe the ASF 44 and ASP 48. (*See*, Office Action, pg. 3.) However, the Examiner has failed to identify which specific operations performed by Hui’s speech processor the Examiner believes are equivalent to a “filtering operation of said at least one noise reference signal is performed with one or more filters having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as alleged by the Examiner. (*See*, Office Action, pg. 3.) Applicants respectfully request that the Examiner expressly identify in the next official action which operations the Examiner believes anticipates the claimed “filtering operation.” (*See*, Applicants’ claim 1, above.)

18. In contrast to the assertions made in the Office Action, Applicants contend that Hui fails to teach that which is missing from Yang. As noted, Hui is generally directed to a signal processor comprising four main blocks referred to herein as PSPE 42, ASF 44, ALE 46, and ASP 48. (*See*, Hui, col. 4, lns. 52-67.) Applicants first assert that the ASF 44 of does not perform the “filtering operation” recited in Applicants’ claim 1. As described above, ASF 44 converts a received target signal into several outputs. (*See*, Hui, col. 6, lns. 51-62.) A first output, referred to as the sum channel signal, comprises the ‘target signal plus noise,’ while the remaining outputs, referred to as difference channel signals, comprise ‘noise only.’ (*See*, Hui, col. 6, lns. 51-62.) Thus, ASF 44 divides a single input into multiple outputs that are used for further processing. Applicants assert that the operations performed by ASF 44 to divide the input are

not equivalent to a “filtering operation of said at least one noise reference signal is performed with one or more filters having filter coefficients **configured to minimize the weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal**” as recited, in part, in Applicants’ claim 1. (*See*, Applicants’ claim 1, above; emphasis added.)

19. In Hui, the sum channel signal and difference channel signals output by ASF 44 are provided to ALE 46 for additional processing. (*See*, Hui, col. 7, col. 7, lns. 15-21.) Applicants assert that ALE 46 also fails to perform the “filtering operation” recited in Applicants’ claim 1. The purpose of ALE 46 is to utilize the difference channel signals to reduce the noise within the sum channel to a small error signal e_c . (*See*, Hui, col. 7, col. 7, lns. 15-21.) More specifically, ALE 46 filters each of the difference channel signals so as to reduce the target signal therein. (*See*, Hui, col. 13, lns. 7-67.) These filters are designed to reduce as much of the target signal there from as possible so that when the filtered difference signals are subtracted from the sum channel signal to form error signal e_c that is, in an ideal situation, “almost interference and noise free.” (*See*, Hui, col. 13, lns. 7-67.) Thus, the outputs of ALE 46 are the sum channel signal, error signal e_c , and filtered difference channel signals. (*See*, Hui, col. 7, col. 7, lns. 33-48.) Applicants assert that the operations performed by ALE 46 to remove a target signal from the difference channel signals is not equivalent to a “filtering operation of said at least one noise reference signal is performed with one or more filters having filter coefficients **configured to minimize the weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal**” as recited, in part, in Applicants’ claim 1. (*See*, Applicants’ claim 1, above; emphasis added.)

20. Also as noted, the outputs of ALE 46 are provided to ASP 48. Applicants assert that ASP 48 also fails to perform the “filtering operation” recited in Applicants’ claim 1. At ASP 48, e_c and the sum channel signal (S_c) are weighted and added to one another to form a weighted average $S(t)$. (*See*, Hui, col. 7, col. 7, lns. 33-48, col. 14, lns. 7-25.) Furthermore, the filtered difference channel signals are summed to form a single signal $I(t)$. (*See*, Hui, col. 7, col. 7, lns. 33-48.) Over a period time, N samples of $S(t)$ and $I(t)$ are formed into vectors and converted into the frequency domain where additional processing is performed to further suppress the unwanted signal (noise). (*See*, Hui, col. 7, col. 7, ln. 33- col. 8, ln. 9; col. 14, ln. 7- col. 18, ln. 45; claim 1.)

21. Applicants assert that the operations performed by ASP 48 to form $S(t)$ and to perform frequency domain processing on vectors comprising N samples of $S(t)$ and $I(t)$ are not equivalent to a “filtering operation of said at least one noise reference signal is performed with one or more filters having filter coefficients **configured to minimize the weighted average of the speech distortion energy and the residual noise energy in said output version of said speech signal**” as recited, in part, in Applicants’ claim 1. (*See*, Applicants’ claim 1, above; emphasis added.)

22. For at least the reasons detailed above, Applicants assert that the combination of Yang and Hui fails to anticipate or render obvious the invention recited in claim 1. Therefore, Applicants respectfully request that the rejection of claim 1 under 35 U.S.C. §103 be reconsidered, and that it be withdrawn.

Claim 9

23. Applicants’ claim 9 is directed to a “signal processor for reducing noise in a speech signal.” (*See*, Applicants’ claim 9, above.) The signal processor of Applicants’ claim 9 comprises “a second filter configured to filter said at least one noise reference signal...wherein said second filter has filter coefficients configured to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions in said output version of said speech signal.” (*See*, Applicants’ claim 9, above.) For at least the reasons discussed above with reference to claim 1, Applicants assert that the combination of Yang and Hui fails to anticipate or render obvious at least these elements of claim 9. Specifically, as noted above, the Hui fails to disclose a filter having “filter coefficients configured to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions” as recited in claim 9, above. As such, for at least these reasons, Applicants assert that the combination of Yang and Hui fails to anticipate or render obvious the invention recited in claim 9. Therefore, Applicants respectfully request that the rejection of claim 9 under 35 U.S.C. §103 be reconsidered, and that it be withdrawn.

Claim 16

24. Independent claim 16 is directed to a “signal processor configured to reduce noise in a speech signal.” (*See*, Applicants’ claim 16, above.) The signal processor of Applicants’ claim

16 comprises “a means for filtering said at least one noise reference signal... wherein said means for filtering said at least one noise reference signal is configured to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions in said output version of said speech signal.” (See, Applicants’ claim 16, above.) For at least the reasons discussed above with reference to claim 1, Applicants assert that the combination of Yang and Hui fails to anticipate or render obvious at least these elements of claim 9. Specifically, as noted above, the Hui fails to disclose “means for filtering said at least one noise reference signal is configured to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions in said output version of said speech signal” as recited in claim 16, above. As such, for at least these reasons, Applicants assert that the combination of Yang and Hui fails to anticipate or render obvious the invention recited in claim 16. Therefore, Applicants respectfully request that the rejection of claim 16 under 35 U.S.C. §103 be reconsidered, and that it be withdrawn.

Claim Rejections under 35 U.S.C. 103(a) in view of Yang, Hui and Additional Prior Art

25. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Yang and Hui in further view of U.S. Patent No. 6,178,248 to Marsh, (hereinafter, “Marsh”). The Examiner has also rejected claims 3-4 and 10-11, 17-18 under 35 U.S.C. 103(a) as being unpatentable over the combination of Yang and Hui in further view of U.S. Patent No. 6,449,586 to Hoshuyama, (hereinafter, “Hoshuyama”). Without addressing the apparent lack of motivation to combine Yang and Hui with Marsh or Hoshuyama, Applicants respectfully assert that the above rejections of Applicants’ claims are improper for at least the reason that the proposed combinations fail to anticipate or render obvious all elements of claims 3-4, 10-11, 13 and 17-18, respectively.

26. As noted above with reference to the rejection of claim 1 under 35 U.S.C. §103, the combination of Yang and Hui fails to teach that which the Examiner asserts. Specifically, the combination of Yang and Hui fails to anticipate or render obvious “filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. Applicants further assert that Marsh and Hoshuyama fail to teach that which is missing from Yang and Hui.

27. Because dependent claims 3-4, 10-11, 13 and 17-18 incorporate the subject matter of their respective independent claims (1, 9 or 16), Applicants assert that Yang, Hui, Marsh and Hoshuyama, taken alone or in combination, fail to render obvious all elements of Applicants' claims. As such, Applicants respectfully assert that the rejections under 35 U.S.C. §103 are improper and should be withdrawn.

Dependent Claims

28. The dependent claims incorporate all of the subject matter of their respective independent claims and add additional subject matter, which makes them *a fortiori* and independently patentable over the art of record. Accordingly, Applicants respectfully request that the outstanding rejections of the dependent claims be reconsidered and withdrawn.

Conclusion

29. In view of the foregoing, Applicants respectfully submit that this application is now in condition for allowance. A notice to this effect is respectfully requested.

30. Applicants make no admissions by not addressing any outstanding rejections or basis of rejections. Furthermore, Applicants reserve the right to pursue any cancelled claims or other subject matter disclosed in this application in a continuation or divisional application. Thus, cancellations and amendments of above claims, are not to be construed as an admission regarding the patentability of any claims.

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